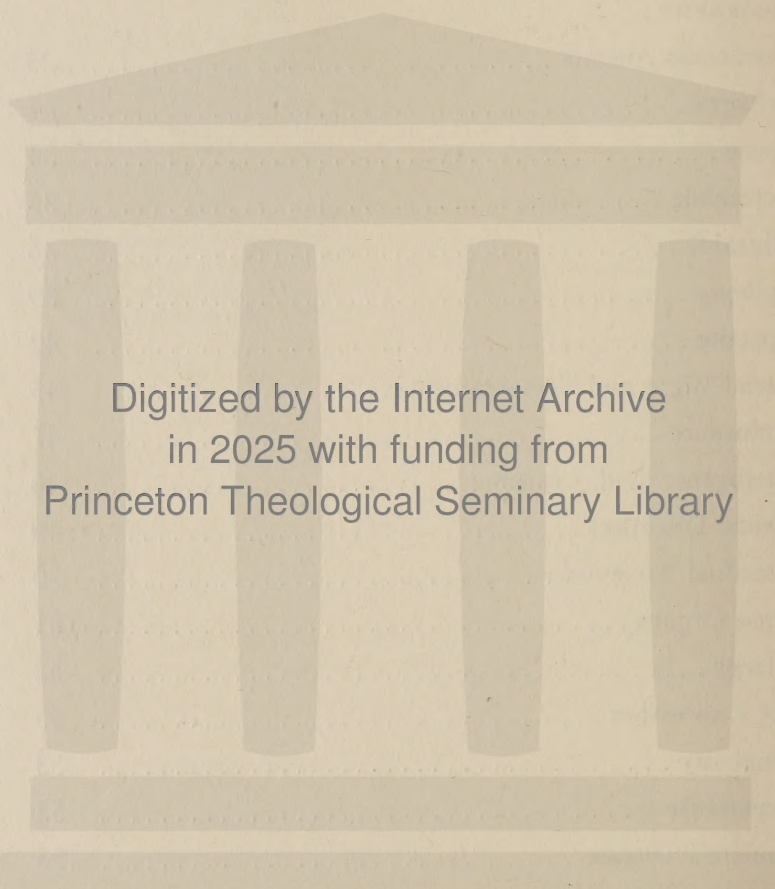


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A CLASSIFIED BIBLIOGRAPHY ON PSYCHODIETETICS *

BY

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The relationship between diet and mental phenomena is known as *psychodietetics* and has been defined as "the science of the feeding of an individual in sickness and in health with particular reference to the mental aspect" (669).

There is now a sufficient number of reports on various phases of psychodietetics to make a comprehensive review desirable. Considerable difficulty is encountered in compiling a bibliography not only because of a tremendous literature on diet and nutrition but also because observations of psychological importance are frequently given only incidental consideration. This means that in many cases material of interest to the psychologist lies hidden in reports which are primarily concerned with biochemical and dietetic descriptions. The fact that only a few articles have appeared in strictly psychological journals indicates that psychologists have not, as yet, greatly concerned themselves with the possible relationship between diet and behavior. There is every reason to believe that an experimental attack upon the problems of psychodietetics from the psychological angle will result in much valuable information.

In general, the references have been classified according to topics which receive common attention in the journals. Articles which might be more appropriately considered under the headings of "fasting" and "drugs" have not been included.

This bibliography has been arbitrarily limited to references appearing in English up to the year 1933.

Pernicious anemia.—Considering the frequency with which mental and neurological symptoms are found in pernicious

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anemia, it is strange that this disease has not received more psychological consideration. Hulett (50) has emphasized the prevalence of mental disturbance and has pointed out the legal significance of this, particularly with reference to wills. It seems that mental involvement has been known for a long time and that Addison who first described the disease in 1855 mentioned the presence of mental disorders (Woltman, 123). It is common practice for investigators to attempt to distinguish between neurological and mental symptoms and while disturbances of a sensory and motor nature are nearly always reported, observations on the higher mental processes have not always been made. However, a number of writers do report observing psychical disorders in their patients (1, 2, 3, 5, 6, 9, 14, 15, 16, 21, 25, 26, 37, 51, 56, 60, 61, 62, 63, 64, 67, 77, 79, 81, 83, 85, 86, 87, 88, 90, 92, 94, 99, 100, 106, 107, 109, 111, 113, 120, 121, 122, 123, 124, 125). According to certain writers there is reason for believing that the incidence of mental difficulties associated with pernicious anemia is actually underestimated. Smith (99) thinks that mental and neurological complications are reported less frequently than they should be. Kiely (57) is of the opinion that in two of his patients, the association of neurotic symptoms and pernicious anemia was merely a coincidence although Barrett (5) feels that his experience has shown the association to be of more than incidental importance. Piney (87) and Winkelman and Eckel (120) suggest that it might be profitable to examine the blood, suspecting pernicious anemia, in all cases of mental disorder. Piney thinks that when the mental symptoms have persisted for a long time, treatment will be ineffective. Barrett (6) and Woltman (123) hold that pernicious anemia plays a more important part in psychiatry than is generally supposed. Menninger (73) thinks that nervous involvement may be so slight as to be overlooked by the physician. According to Atkin (2) pernicious anemia is more often a cause of mental disease than is generally recognized. Hamilton and Nixon (46) state that the neurological examination is often poorly made or that there may even be a lack of any such examination. Murphy (79) expresses the belief that anemia is more common than is ordinarily sup-

posed, and that neurasthenia or even mild psychoses may result from only a moderate diminution of the hemoglobin over a long period of time. Hulett (50), after a review of the reports in the literature, estimates that mental or neurological symptoms or both are found in about 90 per cent of the cases. In view of the opinions which we have cited, this estimate may be somewhat too low. This only increases the psychological significance of the malady.

From a number of reports it seems probable that neurological and mental symptoms may be present before the typical blood picture has developed (2, 10, 14, 22, 26, 29, 44, 46, 52, 54, 57, 61, 73, 88, 89, 90, 93, 113, 114, 120, 124).

According to Sturgis, Isaacs and Riddle (102) as well as Baker, Bordley and Longcope (4), the use of liver in the treatment of this disease dates from the 1926 publication of Minot and Murphy (74, 75, 76, 77). Other investigators have since found that desiccated hog's stomach is fully as efficacious as liver (13, 24, 25, 97, 103, 104, 119). Ungley (107) finds that whole brain is also effective. The influence of vitamins has received consideration (28, 31, 39, 40, 41, 58, 59, 70, 71, 72, 98, 105, 154). The question of liver extract has not been considered in this review since it belongs in the field of drugs rather than diet.

One of the interesting phases of treatment with liver or hog's stomach is the rapid mental improvement. The patient becomes brighter, feels stronger and seems to take a renewed interest in life and his own treatment (13, 47, 60, 64, 67, 92, 100, 102, 104, 110, 111, 115). There seems to be little doubt that the blood picture is markedly improved through the feeding of liver (68) but whether or not the neurological symptoms and cord lesions are likewise improved is a point over which there has been considerable controversy. A number of writers have denied that any benefit results and that at best the symptoms are merely prevented from becoming worse (1, 12, 23, 29, 30, 36, 37, 38, 52, 55, 56, 69, 82, 83). On the other hand there are a number who report objective improvement (3, 4, 8, 14, 35, 41, 42, 53, 60, 66, 67, 70, 73, 84, 92, 102, 106, 107, 108, 111, 116, 118). There are

those who report somewhat variable results and who, in general, have not taken a decided stand upon the question (32, 33, 47, 63, 76, 77, 80, 81, 87, 94, 100, 101, 102, 126). Some investigators are convinced that it takes more liver to influence the neurological symptoms than is required for the blood (7, 101, 106, 108, 112).

Return of sexual activities is mentioned by Conner (25), and Isaacs, Sturgis and Smith (55).

Cornell (27) finds no evidence that dietary habits in the pre-pernicious period are the cause of the disease. Some writers have expressed the belief that pernicious anemia is a toxic condition (6, 51, 52, 65, 71, 89, 91, 94, 120, 126) although Whipple (117) doubts this. It has been suggested by Habershon (45), Herrick (48), and Scatliff (95) that emotional shock may be a causal factor. Recent evidence tends to favor deficient or defective gastric secretion (8, 18, 19, 20, 78, 96, 111, 116, 117). Pernicious anemia should be distinguished from other types of anemia (11, 17, 34, 40, 43, 45, 49, 59, 111, 112).

Pellagra.—This malady is found mostly in the Southern States and is of sufficient importance to have commanded the attention of the United States Public Health Service. Goldberger (143) estimated that in 1927 some 120,000 people in the United States suffered from an attack of pellagra. According to Wheeler and Sebrell (207) there were 7,146 deaths in 1930 recorded as due to this disease, and they estimate that there were at least a quarter of a million cases not including those of a minor degree. Cooper (133) states that pellagra as a disease entity has been known for about 200 years. However, it seems that Harris (156) was probably the first to call attention to it in America in 1902.

The literature on pellagra is filled with observations on mental symptoms and writers almost universally mention them when describing the malady (128, 129, 130, 133, 136, 138, 139, 140, 142, 148, 151, 153, 156, 157, 159, 161, 162, 163, 165, 166, 168, 170, 171, 172, 175, 177, 178, 181, 182, 183, 184, 185, 186, 189, 190, 191, 192, 193, 197, 198, 199, 203, 205, 206, 208, 211, 214). It is almost impossible to make a rational classification of the mental disorders associated with pellagra for there seems to be no characteristic pattern. The one mental symptom which could prob-

ably be considered typical is depression. Wood (214) does not think that insanity is necessarily an essential feature, though frequently present. Thurlow (198) is inclined to believe that pellagra uncovers a latent psychosis. On the other hand, there are some who believe that whatever may be the cause of the physical symptoms is also directly responsible for the mental disturbances (142, 165, 166, 183, 191, 192, 205). Langworthy (167) found upon necropsy a marked nervous degeneration. It is probably a fair interpretation to say that most writers consider the presence of mental symptoms of more than incidental importance.

That mental symptoms may occasionally precede the erythema is considered possible by Roberts (186), Shattuck (191), and Wood (214).

Nesbitt (179) finds that the economic situation, as related to food, has an effect upon the incidence of pellagra. Important differences in dietary practices between pellagrous and non-pellagrous families, as well as a seasonal variation in the supply of milk and succulent vegetables, was found by Sandels and Grady (188). Voegtlin (203) suggested that a restricted vegetable diet is the primary cause. One of the earliest etiological theories, now discarded, was that spoiled maize contained a toxic substance (129). Jobling and Arnold (164) favor intestinal intoxication, and Spies (195) mentions the possibility of a gastric disorder. Deficient diet is favored by Grimm (153), O'Leary (180), Pound (182), Vedder (201), and Warnock and Dudgeon (205), but as the only factor, is opposed by Enright (135) and Harris (158). McCollum and Simmonds (174) feel that too much weight should not be given any particular dietary constituent but that a dietary balance should be considered when interpreting the etiology of pellagra. Smith (194) believes that an abnormality of sulphur metabolism or a deficient supply of cystine is indicated by the evidence. Some form of infection is considered by Harris (158), MacNeal (177), and Viswalingam (202) to play an important part and this is the conclusion reached by the Illinois Pellagra Commission (163) in 1912. Deficient protein has been considered and Ridlon (184) finds that

pellagrins have a dietary history indicating low animal protein consumption. Guthrie (155) favors protein deficiency; Wilson (209, 210) does also and opposes the vitamin theory while Goldberger (141, 144, 147, 150) finally discarded the deficient protein theory and declared quite definitely in favor of vitamin deficiency, even naming the vitamin P-P or pellagra-preventive (142, 143, 146, 149). Greer (152) believes that a low protein allowance will result in a deficient supply of the necessary vitamin. Lustberg and Birchett (173) reject the infection theory and support vitamin deficiency. Aykroyd (127) attacks protein deficiency and is favorably disposed towards avitaminosis. Guha (154), Hindhede (160), Leader (169), and Wood (212, 213, 214) accept vitamin deficiency and this seems to be the theory most favored at present according to Thatcher (196) and Underhill (200) who have reviewed the literature on pellagra. However, Sabry (187) opposes the theory and Bliss (131) thinks an iron rather than vitamin deficiency is indicated while Guha (154) considers iron not the sole factor but a limiting one. Regardless of the etiological theory which may be favored, treatment is nearly always dietetic (130, 132, 134, 137, 141, 145, 146, 149, 158, 165, 170, 173, 184, 185, 204, 205, 208, 214).

In 1915 Goldberger (140) attempted experimentally to produce pellagra in a group of eleven convicts and the results, he felt, justified the conclusion that it is of dietary origin. MacNeal (176) has expressed doubt that pellagra was actually produced in this experiment.

Sprue.—Until recently, sprue was considered a purely tropical disorder but Musser (224) thinks it will be found more and more prevalent in the United States as time goes on. Its similarity to pernicious anemia and pellagra has been noted by Baumgartner and Smith (218), Elders (220), Reed and Wyckoff (89), and Wood (226, 227). The general opinion seems to be that sprue should be differentiated from these two diseases.

Mental and neurological symptoms (Ashford, 215, 217; Baumgartner and Smith, 218; Musser, 224; and Reed and Wyckoff, 89) seem to be a part of the syndrome, among which have been mentioned asthenia, anorexia, "nervousness," pains in

the body, pronounced depression, sleeplessness, mental hebetude, poor memory, nightmares, neuralgias, irritability, excitability, numbness and tingling, anesthetics, paresthesias and flexor contractions.

The etiology of sprue is still in doubt. Ashford (216) suspects a mycosis superimposed upon a food deficiency or that it is a glandular deficiency due in part to an ill-balanced diet. Musser (224) doubts the etiological significance of diet but admits its value in treatment. Others (Elders, 220; Fontaine, 221; Manson-Bahr and Willoughby, 222) have great faith in dietary cures. Nye, Zervas and Cornwell (225) conclude that *Monilia psilosis* is unimportant as an etiological factor. Liver has been found to be efficacious by Bloomfield and Wyckoff (219), Minot, Murphy and Stetson (223), and Manson-Bahr and Willoughby (222).

Acrodynia.—Acrodynia, also known as Swift's disease, Feer's disease, pink disease, erythredema, erythredema-polyneuritis, dermatopolyneuritis, and "raw-beef hands and feet," is a display of certain symptoms such as photophobia, paresthesia, irritability, almost incessant whining or crying, chewing of the fingers, sleeplessness, anorexia and marked changes in disposition which certainly make it a syndrome worthy of psychological recognition. Mental and neurological symptoms occupy a prominent place in descriptions of the disease (228, 229, 231, 232, 233, 239, 240, 242, 243, 244, 249, 250, 251, 255, 258, 266).

According to Wyckoff (264), Bilderback (228) in 1920 was the first to report cases in America. The disease is probably not common (Helmick, 242), and seems to be confined almost entirely to very young children. Wyckoff (264) thinks it may occur in old or improperly nourished adults and White (261) reports two adult cases but the diagnosis is not accepted by Kernohan and Kennedy (243).

The etiology still remains obscure. Many writers (229, 230, 232, 236, 239, 240, 243, 247, 252, 253, 256, 257, 264) favor some form of infection or toxic condition in spite of a lack of definite evidence. Dietary treatment is frequently suggested (232, 237, 239, 244, 264). Favorable results have been secured through

the use of yeast (245, 248, 250, 267) and Wyllie and Stern (265) report rapid improvement when raw liver is administered. A relationship to pellagra is suggested by Bilderback (229), Weston (260), and Wood (262, 263) but rejected by Byfield (232), Emerson (235), McNeal (246), and Vipond (256). Giffen (238), Perlman (251), and Weston (259) accept some form of food deficiency as the cause while Helmick (241, 242) supports allergy. McNeal (246) rejects both food deficiency and upper respiratory tract infection. Craig (234) and Sweet (254) report relief through the use of ultra-violet light. Nesbit (248), writing in 1932, concludes that the deficiency theory is rapidly becoming the prevailing opinion. It is interesting to note that while food deficiency may not be accepted as the cause, nevertheless, dietary treatment is very commonly recommended.

Migraine.—This disorder, known since the time of Hippocrates (Rupert and Wilson, 323), has not received the psychological consideration which its symptomatology would demand. It is characterized chiefly by a periodic headache which Balyeat and Rinkel (276) report is unilateral in 94 per cent of the cases and generalized in the remainder. Other symptoms mentioned are a period of depression preceding an attack, nervousness and irritability, bulimia, druggy or profound sleep on the night preceding the headache, faintness and vertigo, scintillating scotomata, hemianopsia, photophobia, paresthesia of hands, feet or face, motor aphasia, mental confusion, nausea, emesis and exhaustion even to the extent of prostration (276, 279, 280, 296, 297, 302, 310, 313).

As to the prevalence of migraine, Balyeat and Rinkel (276) consider 7 per cent of the population a conservative estimate, while Bramwell (281) found 12 per cent of a class of senior medical students suffered or had suffered from the disorder. McClure and Huntsinger (309) present figures to show that 83 per cent of their patients developed migraine before the age of twenty. Allan (269) reports that many leading authorities believe there is an association with neuropathic taint, but he himself vigorously denies this and presents statistics to support his contention. There seems to be a very prevalent notion, sup-

ported by Ely (291), that there is some sort of relationship between migraine and epilepsy. This idea is attacked by Barborka (277), Bramwell (281), Gowers (296), Hubbell (300), and Moloney (314). Certain writers (Riley, Edinger, and Crookshank) are quoted by Allan (268) as favoring the belief that migraine is more prevalent among the cultured, professional, upper-class or brain workers, but Auerbach (268) doubts this. Allan gives figures to show that there is no relation to occupation. Riley (317) and Rupert and Wilson (323) think that considerably more women than men are affected but Allan (270, 272) concludes there is no sex difference in the number of sufferers although there is a difference in intensity. Buchanan (286) thinks there is no harmful influence on longevity. Allan (271) finds that more than half of the patients have an attack once in two weeks or oftener.

Many theories have been advanced on the etiology of migraine (Gordon, 294). Bramwell (281) believes that anxiety and worry are important in precipitating an attack. An experimental demonstration of a poison in the blood is reported by van Leeuwen and Zeydner (307). Hurst (303) finds no evidence in favor of a gastrointestinal toxemia but Hartsock (298) accepts this explanation. Carbohydrates are suspected by Brown (283, 284, 285) and Minot (312). The ketogenic diet is favored by Barborka (277, 278), Pollock and Barborka (315), and Schnabel (324). Dietary measures, in the experience of Kennedy (304), never cure but do reduce the frequency of attacks. Although allergy is denied by Hartsock (298), Hartung (299), and Stevens (326), there are many writers who very definitely favor some form of sensitization as an explanation of the cause (273, 274, 275, 276, 279, 282, 283, 284, 285, 287, 288, 289, 290, 292, 305, 306, 308, 309, 311, 314, 316, 318, 319, 320, 321, 322, 325, 328, 329, 330).

Epilepsy.—It is not necessary to emphasize the psychological importance of epilepsy because the profound and characteristic mental symptoms are already well known (335, 336, 339, 344).

Estimates on epilepsy show that there must be some hundreds of thousands of cases in the United States. Allan (269) agrees

with Clark (342) who gives 0.20 to 0.33 per cent of the general population. Robertson (382) gives 235,000 cases and Davenport (353) reports 5.15 per thousand for 2,500,000 drafted men during the World War. Barborka (331) thinks 500,000 is a conservative estimate.

Collier (351) and Robertson (381, 382) consider epilepsy to be caused by a toxic condition. A number of writers have proposed allergy as a cause (290, 352, 363, 365, 366, 371, 383, 384, 387, 388, 395, 397, 398, 399). Allergy is rejected by Cohen and Lichtig (350), Felsen (354), Lennox and Cobb (364), Moloney (314), and Smith (386). Wilder (402) was probably the first to report on the value of the ketogenic diet in reducing or controlling epileptic seizures and this method of treatment has received considerable support (331, 332, 333, 334, 337, 338, 357, 358, 359, 360, 361, 362, 364, 368, 373, 374, 375, 376, 377, 378, 379, 386, 389, 390, 391, 392). Bridge and Iob (337) suggest that the ketogenic diet is effective due to the removal of surplus extracellular fluid from the body but Cameron (340) presents evidence to show that dehydration by means of a low water content diet has no definite effect upon the number of seizures. The most favorable results are secured with the ketogenic diet in cases of petit mal, according to Peterman (375), Higgins (362), and Pulford (379). Barborka (333, 334), Fetterman (355), Higgins (362), Shanahan (385), and Smith (386) urge early treatment before seizures have become fixed and it seems necessary to enforce the diet rigidly (Barborka, 332; Harper, 358; Henderson, 361; and Shanahan, 385) since the patients will often secretly obtain other food, particularly carbohydrates. Rowe (319) believes that the ketogenic diet is effective partly because foods to which the subject may be sensitive, such as wheat and milk, are removed. Tracy (393) urges dietary treatment but does not make specific recommendations other than a plentiful supply of vitamins. Lennox and Cobb (364) doubt the value of protein restriction. McMurray (367) restricted carbohydrates, along with other therapeutic measures, and found improvement. Walker and Wheeler (396) found that convulsions decreased on a pellagra-producing diet. Weeks, Renner, Allen and Wishart (400)

tried various special diets and came to the conclusion that they were neither harmful nor beneficial. Although Clark has been one of the strongest exponents of the theory that epilepsy is psychogenic (343, 344, 346, 347, 349) and suggests reëducation (345) in its treatment, he is also favorably disposed toward a low protein diet (348) and has urged dietetic treatment (341). Just how the psychogenic theory, also defended by other writers (Fox, 356; Marsh, 369; Martin, 370; Orbison, 372; Richmond, 380; Turner, Read *et al.*, 394; Wiersma, 401; and Wilson, 403), will be harmonized with the apparent success of the ketogenic diet, remains to be seen.

Appetite.—As early as 1911, Osborne and Mendel (461) expressed the belief that it was not monotony but some deficiency in the diet which brought on anorexia, and this has been confirmed experimentally in recent years. It now seems to be clearly established that a deficiency in vitamin B complex will cause a loss of appetite (409, 414, 415, 416, 417, 418, 419, 420, 423, 424, 425, 431, 433, 436, 438, 439, 443, 448, 463, 468, 470, 471, 472, 473, 475). Sherman and Sandels (468) report that lack of vitamin B (B_1) is more responsible for anorexia than is lack of vitamin G (B_2). Wright (475) thinks the evidence indicates that a direct effect of vitamin B deficiency upon the alimentary tract is responsible for the loss of appetite.

Allison and Davies (404) recommend dietetic treatment to intensify appetite in functional cases and Bartlett (405) has found that fresh calf's liver is beneficial. Twenty-four per cent of 1,471 children coming to the hospital were found by Bartlett to have loss of appetite as a primary symptom. Schultz (466) is opposed to the use of large quantities of cow's milk in a child's diet and finds that its removal aids in overcoming anorexia. Kerley (441) thinks that hyperchlorhydria is a frequent cause of defective appetite in children and that refusal of the breast may be caused by a mental shock to the mother (440). Berkman (407) considers anorexia nervosa but doubts that it is so very common. Kugelmass and Samuel (444) believe that psychic discord will disturb the functions of the alimentary tract which will cause loss of appetite.

That raw vegetables are preferred to cooked ones by children and that a marked desire for food seems to develop gradually are conclusions reached, on the basis of an investigation, by McLaughlin, Tarwater, Lowenberg, and Koch (454). Food dislikes acquired in childhood are thought by Rice (464) to have an influence upon metabolic disorders of middle life. Young (476, 477) has developed a method of studying objectively the preferences of rats and finds that they prefer in order milk, sugar, butterfat, wheat and flour. Levine (445) states that the Eskimo actually dislikes sugar and gets used to salt more quickly than to sugar. Gauger (429) found that preschool children will modify their responses to an apparently disagreeable taste stimulus. Holder, Smith, and Hawk (435) conclude that utilization is not affected by palatability. McCollum (452) found that by giving attention to the palatability of food the decrease in body weight of rats could be deferred but not permanently stopped.

Instinct as a guide to food has been speculated upon a great deal and has also received some experimental consideration. A number of writers favor the idea that there will be a relatively correct choice of diet when the animal is presented with a variety of foods, some authors postulating an instinct while others suggest some sort of chemotropism (406, 408, 412, 418, 421, 422, 424, 427, 432, 434, 437, 447, 449, 450, 451, 456, 457, 459, 460, 462, 465, 474). In 1906, Fisher (428) performed an experiment on "natural eating" and found a voluntary reduction in the consumption of flesh foods. However, Chittenden (413), Kon (442), Levine (445), McCollum, Simmonds, and Pitz (453), and Nevens (458) doubt that any innate craving or appetite can be safely relied upon. Slonaker and Card (469) observed increased cannibalism in rats when the supply of animal protein was reduced, which they attribute to a craving for animal protein. Sherrington has implied that the aversion of dogs for dog meat is nearly universal, but Girden (430) and Maslow (455) do not find this to be the case.

Racial Vigor and Temperament.—An attempt has been made to explain racial and national differences on the basis of diet. The idea seems to be quite prevalent that the less vigorous

people, lacking initiative and energy, are vegetarians. The Chinese and Japanese, as well as other Orientals, are frequently referred to in order to support this hypothesis (Adolph, 478; Armitage, 479; DuBois, 486, Lorand, 496). Chittenden (413) quotes Oshima (510) as saying that the Japanese rural population of the interior eats fish but once or twice a month and meat almost not at all. This is in disagreement with Hirai, quoted by Holt (492) as stating that the Japanese "rarely get meat but take much fish." However, Oshima writes that there have been too few investigations to warrant a definite conclusion on the national diet. Chun (483) suggests that a small amount of animal protein and deficiency of fat-soluble vitamin are responsible for the lack of energy among the Chinese poorer classes. Benedict (406) considers that productive power, enterprise and civilization are associated with liberal quantities of protein. Hitchcock (489, 490) has studied the effect of protein upon voluntary activity of the white rat and finds that a diet containing 12 per cent protein of vegetable origin depresses activity. Slonaker (512, 513, 514) also found that a vegetarian diet so much decreased the activity of the white rat that it resembled senile conditions. Conger's (484) investigation showed that rats on a well balanced diet voluntarily took more exercise than those on diets either lacking animal protein or containing a very large amount. Tang, Chin, and Tsang (516) studied the effects of a vegetarian diet upon learning ability in rats. Wu and Wu (526) conclude that no adequate vegetarian diet for the white rat is known at present. McCollum, Simmonds, and Parsons (500) favor a liberal amount of protein in the diet but believe that it is dairy products rather than meat which is responsible for racial vigor. Low efficiency, reduced morale, loss of endurance, fatigability, tendency to forget and loss of initiative among the people of Germany during the World War are attributed by Mason (502) to a low protein diet. Hindhede (160) favors a vegetarian diet with but a small consumption of meat.

It has been stated that animals fed a meat diet become vicious and dangerous while a vegetable diet will make them tame and easily trained (Liebig, 495; Lorand, 496; and Carpenter, 412).

These characteristics of viciousness and docility are likewise supposed to vary with diet in human beings. However, DuBois (486) calls attention to the fact that the meat-eating Eskimo is perhaps the most peaceful and unwarlike race in the world. Stefansson and Anderson lived on an exclusive meat diet for a year without any apparent ill effects and no decrease in mental vigor was observed (Lieb, 493, 494; and McClellan, 498). Miles (481) found that the psychological effects of a limited food consumption were, in general, rather small. Although productivity and initiative have often been ascribed to the type of food consumed (Berman, 408; Grayson, 487; and Murlin, 508), it seems that Sherman (511) and Wherry (522) have been among the few bold enough to challenge this hypothesis. Wherry points out that with the high incidence of beriberi in Japan and hookworm in India, we may well question whether or not a low protein diet is the cause of racial inferiority. When vegetarianism is voluntarily assumed, it is remarked by Mendel (504) that it generally involves a moral aspect rather than a physiological basis.

Berman (408), in discussing the food habits of leaders, calls attention to the enormous meals consumed by Bismarck, exponent of the "blood-and-iron" policy, and Penrose, political boss of Pennsylvania, as contrasted with the abstemiousness of Gladstone and Mahatma Gandhi. Crile (485) suggests that a hyperkinetic drive may be due to autointoxication (foreign proteins) and excessive diet. Trembly (518) observed that white rats on a ketogenic diet were considerably more active than the control animals. Weston (521) reports that with vitamin C deficiency there may be observed a change in disposition. Stern (515) expresses his belief in a relationship between diet and personality.

The specific dynamic action of food, especially protein (480, 486, 497, 507, 524), and metabolism in relation to the psychological situation has received some consideration. Whitacre and Blunt (523) investigated the relationship of temperamental type to the dynamic effect of food. They were unable to show any difference between vivacious and placid individuals. It has been observed that Orientals possess a lower basal metabolism than Occidentals (501, 503, 506, 509) even when a correction is applied

to the usually accepted standards for women. Heinbecker (488) has shown that the basal metabolism of the Eskimo is about one-third higher than for people living in temperate zones. Wakeham and Hansen (519, 520) find that long-time vegetarians have a somewhat lower basal metabolism while Wu and Chen (525) find the values for vegetarian rats somewhat below those of omnivorous rats. Benedict and Roth (482) doubt that a vegetarian diet alters basal metabolism.

It has been McCollum's (499) experience that white rats may not show any immediate effects of certain mildly unfavorable diets but there will be cumulative effects so that the strain dies out after three or four generations. Minot (505) has expressed his belief in such cumulative effects in the case of human beings. Whether or not such physical deterioration through several generations is also accompanied by mental deterioration has not been specifically investigated.

Endurance.—Considerable attention has been given the possibility that the amount of protein in the diet is a factor in endurance. Berry (528), using a two mile run as a test of ability to resist fatigue, found that results always favored the low proteid group. The investigation was carried on for a period of four months. According to Chapin (529), a reduction in proteid food will, in a few days, permit a greater output of work, but Bassett, Holt, and Santos (527) found no demonstrable effect upon physical capacity when meat was withheld from the diet for a period of a week. Fisher (428, 530, 532) concluded on the basis of experimental evidence that a low-proteid, non-flesh dietary was a decided advantage from the standpoint of endurance. He has also called attention to a Belgian experiment which was found to support his results (531). Hindhede (533, 534) reports that men on a low vegetable protein diet have unusual capacity for work and endurance. Grayson (487) is of the opinion that a vegetarian diet increases endurance. Howe (535) observed the effects of high and low protein diets on ergographic responses. He concluded that the advantages were essentially in favor of a low protein diet. Thompson (542) opposes a strictly vegetable diet on the ground that it induces muscular weakness and languor.

In his opinion, animal food in some form is absolutely essential to vigor. The loss of efficiency and loss of endurance, among other effects noted in Germany during the war, are attributed by Mason (502) to the low protein diet. Langworthy (538) reports that four out of six successful contestants in a strength and endurance test, who later furnished data, had lived upon an ordinary mixed diet. It should be pointed out that the complications in the problem of endurance as related to protein, apparently have not always been clearly realized. The question of animal vs. vegetable protein may be quite distinct from the question of a high vs. low protein diet.

Berman (408) describes the sustaining effects of sugar in the case of marathon runners. Lorand (496) agrees that sugar possesses counter fatigue effects while Laird (537) reports experimental confirmation of this fact. Krogh and Lindhard (536) found that four out of six subjects experienced, subjectively, less fatigue on a high carbohydrate diet than on a high fat diet.

Nelson and others (539) have shown that the absence of vitamins A and B in the diet of the white rat will result in lessened muscular endurance. A clinical case is reported by Peters (540) where an increase in vitamin B in the diet caused a rapid disappearance of listlessness and fatigability. Talbot (541) mentions poor food habits and malnutrition as one of the many causes of fatigue. Miles (481), in a study of reduced food intake, found no objective effects but, subjectively, there was a distinct tendency to report lowered endurance and greater susceptibility to fatigue. Holck (491) reports that "Fletcherizing" decreased muscular endurance.

Intelligence and Learning.—Considering the popular belief in a close relationship between the state of nutrition and mental ability, it is strange that so few experiments have taken up this question. Levine (562) believes that malnutrition has marked psychological effects. Graper and Park (557) and Holt (492) are on record as favoring some connection between mental development and nutrition. McCollum (563) believes that a very poor diet will dull the mental capacity of children and warp their personalities. This viewpoint is opposed by other writers.

Blanton (547), after an extended study of malnourished children in the immediate war area of Germany, came to the conclusion that very few had suffered any permanent impairment of intelligence, although lack of energy and marked susceptibility to fatigue were noticeable. He also failed to find any definite increase in the number of children suffering from neuroses and psychoses. Dowd (551) reports that even under nutritional care the I.Q. remained substantially the same and this is supported by Smith and Field (575). Rosenberg (573) failed to find any appreciable difference in I.Q. (Stanford-Binet) between underweight children on a meatless and eggless diet as compared to those on a "representative American dietary," after six months of such treatment. Nicholls (571) found that underweight children were inferior to normals on certain tests involving essentially a muscular situation, but there was no difference on tests similar to those used in intelligence tests. Hunt, Johnson, and Lincoln (560), employing a number of psychological tests, found that underweight children actually had a slight advantage. Stalnaker (576) calls attention to the fact that height and weight may not be satisfactory standards for judging malnourishment. Although experiments have met with little success in showing a direct effect of malnourishment upon intellectual capacity, the question still has considerable importance since achievement may be lowered through lassitude and ill health. Levine (561) presented statistics in 1925 showing that at least four million school children were suffering directly from malnutrition. Bliss (548) found in his study that a fourth to a third of the children were underweight and therefore assumed to be malnourished. Cramer (549, 550) thinks that many people are in a chronic state of vitamin underfeeding and that a lasting weakness may in this way be carried over from infancy.

There is no permanent effect of rickets upon mental development, according to Gesell (556). Peters (572) thinks that there is a noticeable association of rachitis and idiocy. Frank (554) was unable to demonstrate a difference between normal and rachitic rats, although the normals were superior in a relearning test three months later. Anderson and Smith (543, 544) found

that qualitatively and quantitatively stunted rats were superior to those on a normal diet in relearning a maze, but in a second relearning period, following realimentation, they tended to become similar. Using the escape-from-water technique, Ruch (574) showed that young rats on a maintenance diet were superior to those on either a restricted or liberal diet. Pearson (553) is quoted as stating that "health and intelligence are correlated, although not very markedly." Balyeat (545, 546) finds that allergic children are definitely superior to non-allergic in mental activity. An investigation by Hoefer and Hardy (558) shows that breast feeding, when not continued too long, has a favorable influence upon the intellectual ability of children.

The possibility that vitamin B may have some influence upon intelligence and learning ability has been considered. Maurer and Tsai (566, 567, 569) have given this problem experimental consideration and report that lack of vitamin B in nursing rats will result later in a decided effect upon learning ability. However, their generalizations (565, 568) have been very severely attacked (552). Dennett (423) believes that cow's milk, and in some cases human milk, does not contain the optimal quantity of vitamin B. Hoobler, Outhouse, and Macy (559) and Macy, Outhouse, Graham, and Long (564) find that human milk is often deficient in vitamin B, while Moore, Brodie, and Hope (570) find the same thing true in the case of the rat. Fritz (555) did not find that the accuracy of maze performance was affected by a vitamin B-deficient and salt-defective diet in relatively mature rats.

Miles (481) reports that no evidence was found of lessened ability to do college work while on a quantitatively restricted diet.

Holck (491) found that "Fletcherizing" had no significant effect upon sleeping time, mental multiplication and typewriting speed but that typewriting accuracy was reduced.

A vegetarian diet was found by Tang, Chin, and Tsang (516) to have an unfavorable influence upon the learning of male rats but was without effect in the case of females.

Mental disorders.—The term "mental disorders," for purposes of this review, is given a liberal interpretation to include

not only psychoses and neuroses but also so-called nervousness. A variety of references not readily classified under some other topic are here considered.

Fitch (583) discusses the dietary peculiarities which may result from mental abnormality. Levine (562) is convinced that malnutrition will produce marked anatomical changes in the nervous system, and that there will be emotional disturbance, irritability, melancholia and apathetic behavior. On the basis of clinical evidence, Mercier (591) concludes that mental disease, in at least a few cases, is due to error in the diet. Walsh (598, 599) also is of the opinion that many patients suffering from neurotic and psychoneurotic symptoms are only in need of dietary treatment. Buckley (581) considers diet of importance in the treatment of neurasthenia, while Paton (592) thinks our ignorance of the true nature of neurasthenia, as well as metabolism, makes it impossible to formulate any laws for dieting in this situation. Grayson (487) and Lorand (496) believe that a vegetarian diet reduces nervousness. In the opinion of Holt (492), most of the neuroses of childhood depend entirely upon disorders of nutrition. Seham and Seham (594) find that forced feeding and rest cure for malnourished children reduces nervous symptoms. Laird, Levitan, and Wilson (589) present experimental evidence to show that milk given to school children at 9:30 A.M. reduces nervousness. Hartwell and Mottram (585) find that the feeding of brown bread causes rats to become highly nervous and they question the propaganda in favor of brown bread. Bryant (580) considers diet an important factor in the treatment of hyperkinetic individuals. Henry (586) and Richardson (593) are convinced that there is an intimate relationship between emotional disorders and digestive functions. Bostock (578) reports achlorhydria and hypochlorhydria to be surprisingly frequent in the psychoses. Delirium tremens may be successfully handled through dietary measures according to Carter, Howe, and Mason (582). Bronfenbrenner (579) calls attention to the great craving of the feeble-minded for carbohydrates. In contrast with the above findings, we have Appel and Farr (577) and Sher-

rill (595) expressing some doubt that diet is a cause of mental disorders.

Gregg (584), calling attention to the statistics on depression and suicide, makes the interesting suggestion of a connection with vitamin shortage. McCarrison (590, 450) has shown experimentally that brain weight is markedly increased by a diet excessively rich in starch and fat but lacking in vitamin B. He suggests a relationship to mental disorder. Hughes and others (587, 588) have shown that lack of vitamin A results in nervous degeneration in swine and that chickens, cows and pigs will develop incoördination and spasms. Thomas (596) states that vitamin D is valuable in bringing about a reversal of the hemoclastic crises in dementia praecox. Timme (597) reports very little success with the use of calcium mobilizing agents involving vitamins B and D in an attempt to overcome hypocalcemia in patients who were decidedly hyperirritable.

Intestinal toxemia.—The belief seems to be quite prevalent that intestinal toxemia will lead to profound mental disturbances and since its treatment is generally dietetic, it becomes necessary to consider this subject in a review on psychodietetics. Bartle (602) lists certain symptoms which are of psychological significance, such as fatigue, nervousness, sleeplessness, melancholia, anorexia, nausea, prodromal well being, bulimia, drowsiness, headache, migraine, phobias, vertigo, mental hebetude, and vomiting. Mental disturbances are mentioned by other writers (Boles, 603; Cotton, 604; Craig, 352; Crile, 605; Diamond, 606; Fitch, 609; Kauffman, 612; Kraetzer, 615; Satterlee, 617; Satterlee and Eldridge, 618; Stucky, 620; Walker, 622; Wile, 623; and Yearsley, 624).

Alvarez (600), in a review on the subject, leaves the impression that sound scientific knowledge on intestinal toxemia is scarce and that the effects have been somewhat overstated. Andrewes (601) thinks there is little evidence that toxins derived from the ordinary flora of the intestinal tract are important in alimentary toxemia. Fitch (608), in an earlier publication, announced an "open mind" on the subject, while Gant (610) and Wile (623) are somewhat dubious concerning the severe mental effects of

constipation. However, it should be pointed out that most writers differentiate between constipation and intestinal toxemia, although recognizing a close relationship. Gross (611) considers it proved that lack of vitamin B will lead to intestinal stasis. Kellogg (613, 614) has been most vigorous in affirming the evils of constipation. According to Synnott (621), there is no relation between intestinal putrefaction and constipation. Paulsen (616) attacked the problem of intestinal toxemia experimentally and treated a group of 30 girls by dietary methods, adequate elimination, exercise, hydrotherapy, and a cheerful environment. On a large number of psychological tests, the experimental group was found to be quite decidedly superior to an untreated control group, although the difference was greater for motor reactions than in the case of intellectual processes. Donaldson (607) observed five men who engaged in voluntary constipation for a period of nearly four days. A number of symptoms of psychological interest appeared but he concludes that these are to be explained on a mechanical basis, rather than toxic, since they disappeared so quickly after an evacuation by means of an enema.

Allergic toxemia is recognized by Rowe (321) who lists as symptoms drowsiness, mental confusion, slowness of thought, lack of initiative and ambition, irritability, despondency, fatigue, weakness, bodily aching, and a feeling of "being poisoned."

Sense organs.—Nightblindness is perhaps the most prominent sensory disorder of psychological importance associated with diet. Adler (625) has briefly reviewed the literature on nightblindness and Bordley (630) has summarized the controversy over the terminology. Aykroyd (626, 627) calls attention to the fact that this disorder has been known far back into antiquity and that the cure was also known, viz., the eating of liver. Little (634), as well as Aykroyd, has observed much nightblindness among the people of Newfoundland and Labrador. Spence (638) reports that occasional cases due to dietary deficiency are to be seen in the industrial districts of northern England. Enright (631) quotes Keatinge as stating that there was an extraordinary prevalence of nightblindness among native troops in Egypt during

the war. Pillat (636) mentions the malady as one of the eye diseases encountered in Chinese soldiers suffering from vitamin A deficiency. It seems to be well established that lack of vitamin A is the cause (Bloch, 629) and the experimental work, as well as clinical results, indicates this to be correct. Fridericia and Holm (632) found that lack of vitamin A along with exposure to strong light caused a delay in the regeneration of visual purple in the retinae of rats. They were not able to show this when vitamin B was withheld from the diet. Holm's (633) experiments show that the disorder appears very early during the avitaminosis. Tansley's (640) experiments also showed a lowered rate of regeneration of visual purple in white rats fed a vitamin A deficient diet. Smith (637) distinguishes between nutritional nightblindness and idiopathic nightblindness, generally called retinitis pigmentosa.

Peterson (635) mentions that cattle will become blind in three months when fed cotton seed cake. Spivacke (639) reports a case of temporary blindness resulting from an allergic reaction to mustard given as a test for hypersensitivity.

Barlow (628) was unable to show that rickets is a factor in deafness. Weston (641) states that an excess of vitamin B over vitamin A will cause a proliferation of lymphoid tissue sufficient to block the eustachian tubes and interfere with hearing.

According to Weston (641), vitamin C deficiency causes minute hemorrhages into the taste buds, resulting in an absence or perversion of taste.

Allergy.—Certain references to allergy receive consideration under the headings of migraine (273, 274, 275, 276, 279, 282, 283, 284, 285, 287, 288, 289, 290, 292, 298, 299, 305, 306, 308, 309, 311, 314, 316, 318, 319, 320, 321, 322, 325, 326, 328, 329, 330), epilepsy (290, 314, 319, 350, 352, 354, 363, 364, 365, 366, 371, 383, 384, 386, 387, 388, 395, 397, 398, 399), intelligence (545, 546), intestinal toxemia (321), sense organs (639), and Meniere's disease (662). The frequency with which mental symptoms are mentioned in connection with hypersensitivity makes this topic of some importance in psychodietetics.

Duke (644) estimates that about 12 to 15 per cent of the

people are hypersensitive while Rowe (648) considers the figure to be about 30 per cent.

Talbot (653) thinks that the findings on allergy are of great importance. Rowe (320, 649) enumerates symptoms such as confusion, restlessness, irritability, fatigue, dizziness, drowsiness, weakness, nervousness, dullness, and generalized aching. Carr (643) reports the development of headache, nausea, and drowsiness in a patient whenever he was placed on a milk diet. Sherwood-Dunn (652) feels that anemia, neurasthenia, migraine, insomnia, and melancholia are associated with anaphylaxis. Shannon (651) is convinced that anaphylaxis causes nervousness through irritation of the nervous system and that this is also the correct explanation of the so-called neuropathic diathesis. Craig (352) has observed epileptic fits and mental confusion follow the ingestion of eggs and has seen three cases of delirium follow the taking of mushrooms. Andresen (642) thinks it is highly probable that many of the symptoms usually attributed to intestinal toxemia are really due to food sensitivity.

Miller (371) calls attention to the fact that until comparatively recently asthma was considered a neurosis (Gerrish, 646) and even at present many physicians emphasize the importance of nervous phenomena. It seems to be well established that a certain number of patients can be relieved by removing offending foods from the diet (Maisel, 647). Duke (645), who is one of the exponents of allergic theory, has observed mental abnormalities associated with asthma.

Sheard, Caylor, and Schlotthauer (650) found that guinea pigs, white swine and goats displayed photosensitivity after the ingestion of buckwheat. Guinea pigs showed the most marked effects with shaking of the head, excitation, squeaking, scratching of the ears, and intense agitation. Darkness calmed them. No effects were observed in rabbits, dogs, white mice, and white rats.

Sex expression.—It would seem to be probable that sex expression is subject to dietary influence. Miles (481, 656) reports decreased sex interest and activity for 22 out of 24 men who had been placed on a restricted diet. He concludes that a

relatively high metabolic level is necessary for the normal functioning of sex. When male rats are placed on a diet lacking vitamin E they eventually lose all sex interest, according to Evans (654, 655). Fritz (555) was unable to show any sex difference in the maze performance of white rats while on inadequate diets but did find that a significantly greater number of the males survived than the females. Tang, Chin, and Tsang (516) found some sex differences in rats learning a water maze while on a vegetarian diet. Mason (502) writes that due to malnutrition in Germany during the war, there was suppression of menstruation for long periods of time in women and a greatly decreased sexual libido in the men.

Longevity.—Longevity can be significantly improved through enriching the diet, according to the experiments of Sherman and Campbell (657). Slonaker (659) has found life span to be a function of the amount of protein in the diet, the optimum being 14 per cent. A liberal allowance of vitamin A increases length of life considerably, according to Sherman and MacLeod (658).

Hypertension.—Jump (660) reports fatigability, vertigo, lack of initiative, nervous instability, dyspnea, and headaches as symptoms of essential hypertension. He recommends complete rest, a milk diet and the avoidance of foods which disagree with the patient. The elimination of proteins is generally recommended although their effect upon blood-pressure is still undecided. Rowland (661) mentions that headache, neuralgias, paresthesias, vasomotor instability, palpitation, insomnia, and nervous irritability accompany hypertension and advocates a balanced reducing diet as the most important treatment.

Meniere's disease.—This disease may be caused by food allergy, according to Duke (662). In describing this disease, Kopetzky (663) emphasizes the sudden onset of deafness, tinnitus and vertigo, and states that other writers have reported loss of consciousness, double vision, transitory clouding of the visual fields, transitory hemiopia, psychic depression, and loss of memory. Richey (664) reports that improvement has been noted when meat is withdrawn from the diet.

Beriberi.—It is quite universally accepted that beriberi, caused

by a deficiency of vitamin B (F or B₁), will result in peripheral nerve degeneration (Vedder, 667; Zimmerman, 668). Sensory and motor disturbances are characteristic of this disease (Love-lace, 666; Vedder, 667) among which will be loss of deep reflexes, pains in the legs, "pins-and-needles" sensations, paraplegia, peculiar "stiff" gait, anesthesia, paresthesia, and absent or exaggerated kneejerks. It seems there is little evidence that the higher mental processes are affected in beriberi even though Funk (665) has presented evidence which suggests a breakdown of the lipoids of the brain. Farnell and Yacovlev (136) report mental depression at the onset and afterwards indifference accompanied by mental prostration. However, they warn that mental symptoms are not so characteristic as the neurological symptoms, and oftentimes may be absent. It is their opinion that beriberi and pellagra rarely exist independently of each other, which calls attention to the close association of vitamins B and G (B₁ and B₂). Hoobler (436) writes that children suffering from infantile beriberi become restless, fretful, and develop a feeble, plaintive cry as well as displaying neurological symptoms.

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Pernicious Anemia

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